RESEARCH ARTICLE

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Evaluation of Workplaces and Corrective Actions in the Central Iranian Steel Industries

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Background & Aims of the Study: Musculoskeletal disorders (MSD) are one of the important occupational health issues. Prevention of these discomforts requires posture assessment at work stations using ergonomic job analysis methods. The purpose of the present study is to evaluate the work stations and perform corrective actions in one of the central steel industries of Iran to decrease the frequency of these disorders.

Materials and Methods: An Interventional and analytical study were performed at 29 stations on one central steel industries in Iran in 2017. Initially, a primary assessment was done by using RULA method, and after calculating the possibility of musculoskeletal disorders, corrective actions were taken at high risk sites.

Results: In the present study, all participants male with a mean age 33.9 years. The final evaluation of scores at different work stations indicated that 17% of the stations with a risk of level 1, 59% had a risk level of 2, 17% of risk level 3, and 0.07% of risk rate 4. Principally, the consequences of the initial evaluation of the RULA technique are based on the establishment of the "waste breakdown" and "demolition work" duties at risk level 4, which makes changes and ergonomic intervention immediately necessary.

Conclusions: With the carrying out of corrective actions in the "waste breaker" units and "destructive work of the Tundish" as a outcome of the assessment of the RULA technique and providing other ergonomic strategies, including the inclusion of an educational plan focused on ergonomic fundamental, an important stage was taken to decrease the prevalence of skeletal muscle disorders.

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Background

Work-related musculoskeletal disorders (WRMSDs) are consider as common disease and occupational injuries due to undesirable exposure of body in different stage of production, loading and transportation which create the irreversible physical and spinal cord injury (1). The work-related musculoskeletal disorders can affect the muscules, tendons, joints, nerves and soft tissues in the body (2) and 48% of work related disease are about musculoskeletal disorders (3). The National Institute of Occupational Safety and Health (NIOSH) has categorized diseases and complications of job based on their importance (in terms of the frequency of severity and the likelihood of preventing), in which, after respiratory diseases, related musculoskeletal disorders Worked in second place (4). According to available statistics, the prevalence of musculoskeletal disorders among all work-related diseases in Finland was 31% and 44% in the United States (5). Based on the national institute of occupational health and safety,

considering that musculoskeletal disorders are ranked second in terms of the importance and rate of occupational illnesses, and given the cost of these disorders and the status of maintaining the health of the workforce, Work is vital in order to prevent and control healthy behaviors (6). The reasons that cause musculoskeletal disorders due to work are very diverse, but one of the significant factors is inappropriate work postures, so their evaluation is important (7). The assessment of ergonomic risks due to inappropriate body condition can help predict the occurrence of WMSDs (8). Postural analysis is a systematic approach that can be a powerful and effective technique for assessing work activities from an ergonomic opinion of view.

The RULA method is one of the greatest posture estimation methods for the rapid evaluation of the risk of developing musculoskeletal disorders in the high extremity of the body, especially the static work situations (9). The physical status of the employees of the Kerman Frolite factory was evaluated using three methods QEC, RUL and OWAS. In this poject, two QEC and RULA methods for such businesses were proposed (10). Koohpaei els in their study conducted RULA one of most prominent and most widely Used for assessment ergonomic risk reasons (11). Kohammadi by comparing two QEC and RULA technique in carpentry conducted each of these methods has their strengths and weaknesses (12). Musculoskeletal risk factors were also studied in a study on workers of a machinery factory using two methods of QEC and RULA. According to the consequences of this study, an important percentage of workers worked ergonomically in non-living conditions, which requires ergonomic interventions in their work environment (10). Ghasem Khani et al., in a study entitled ergonomic evaluation of workers' situations at the assembly of workers in a RULA automotive plant, showed that considering the priority level of the fourth corrective action that was obtained in the postures, changes were made to advance the working situations through intervention ergonomics should be done promptly (13). Also, in a study by Vermesyar et al. With the aim of evaluating the RULA work position in store chain stores, grocery stores concluded that setting the workstation and using a back protector seat effectively played a role in reducing musculoskeletal discomfort (14). Moradi els in their survey shown that by using REBA method for assessment postures, finally can recommended to improve the working conditions and prevent these disorders (15). In the steel manufacturing, for the manufacture of ingots, the melted material is discharged into the crucible and transferred to the CCM (Continuous Casting Machine) after the transfer of melting material inside the plant to create the ingot. In the CCM section, the discharge of the melt from the plant to Tundish is carried out. Inside the tandem, two holes are located on the right and left sides, through which they go into the production rails. Upon completion of melting, the melt residue in Tundish will be transferred to the Tundish Unit for destruction and refractory work. At this stage, the destruction of the waste is carried out manually and by the destruction of the tandem work.

Following the numerous complaints made by the Tundish unit staff to the professional health professional of the industry, and given that the industry in question has most of the duties assigned to it, the upper extremities are the most active and at risk.

Aims of the study:

In this current study, with the goal the study of work postures by RULA method and ergonomic intermediation of Tundish unit workstations is one of the significant steel industries in Iran.

Materials & Methods

The present study is an interdisciplinary and descriptive-analytical type that was carried out in 29 Tundish workshops in 2017 in one of the central steelmaking industries of Iran. The aim

of the study was fully explained to all contributors in the study, and the workers were pleased with the consent and they were assured that the data of the questionnaire and the photographs would remain private and if the photographs were used, the face of person would be distorted. Demographic data of people such as education, age, weight and height were recorded and the operators were examined for the past of diseases affecting musculoskeletal disorders such as arthritis, rheumatism, etc., or any incident that caused musculoskeletal injuries. None of the signs were listed seen in participating of the study.

After observing and examining the postures of Tundish unit employees, these tasks were such that upper extremities had the highest activity and risk; therefore, to assess workers' posture, the RULA technique was used before and after the intervention; for this item the organ of body is separated into group A (including arm, forearm, wrist) and group B (including neck, trunk and leg). For analysis of postures, each body part is evaluated based on the amount of movement from its standard state. Thus, in accordance with the rise of the deviation of that part of the normal state and its judgment with the 5 diagrams of the RULA method, a number is given as a posture code to it and after combining the codes obtained for different parts of the body and estimating external and muscular strengths through the respective tables, points C and D were obtained and using the final code indicating the intensity of posture and The level of urgency of the reform is determined (9).

After initial evaluation by the RULA method, high stages of corrective actions and inappropriate postures were recognized, and attempts were made to perform the interventions with the lowest cost and the easiest available facilities at work stations; therefore, at all stations, Intervention measures included ergonomic training, engineering design, use of overhead cranes and desktop at some stations. Finally, after the intermediation, the RULA was re-evaluated to determine its efficacy and the results of the assessment were compared before and after the intervention for the workstations with the risk level of the wings.

Results

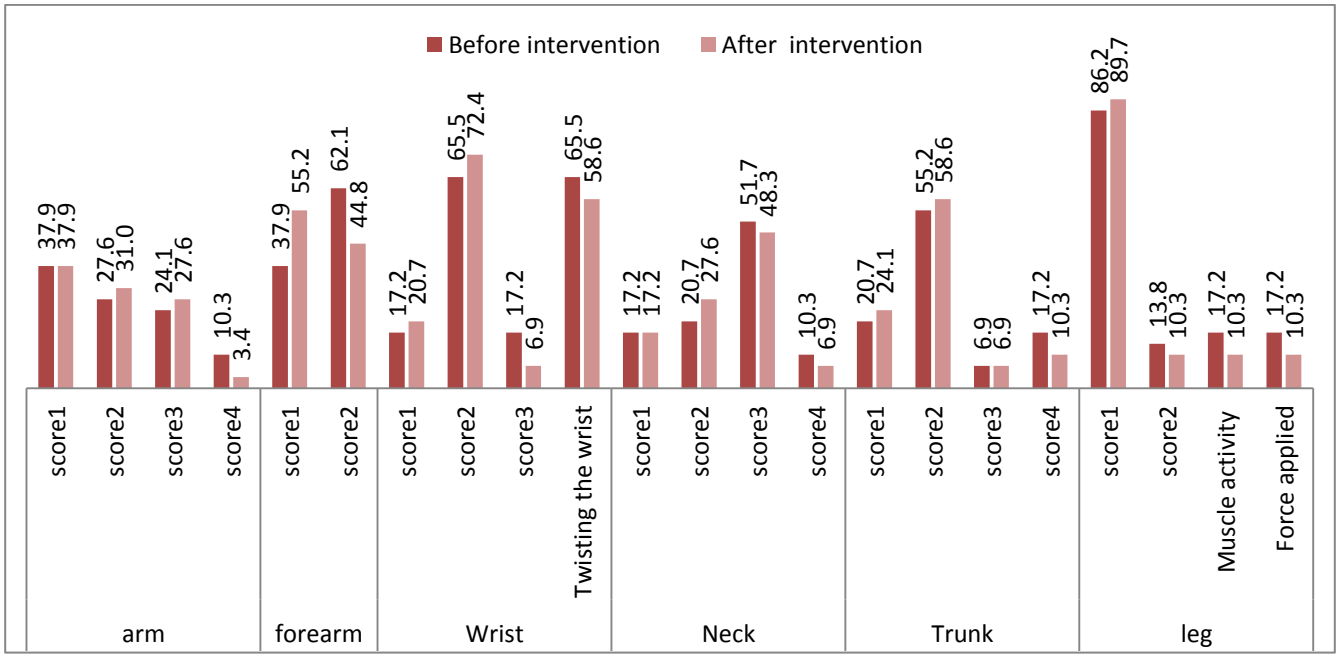
In the current study, all participants were male and their level of education was 10% graduate, 51% high school education and 37.9% undergraduate, respectively. Other demographic data was reported as an average age of 33.9 years old, an average work experience of 2.4 years, an average height of 175.5 (cm) and an mean weight of 81.4 kg.

In the initial assessment of the RULA arm with an angle of more than 90 degrees in 10% of the workforce, the forearm with an angle of less than 60 or more than 100 degrees in 62% of the subjects, wrist twist in 65.5%, wrist with an angle of more than 15 degrees in 17 % of staff, neck stretching at 10%, trunk bending of more than 60 degrees in 17%, legs in inappropriate condition at 13.8%, muscle activity and force were seen in 17.2% of workplace.

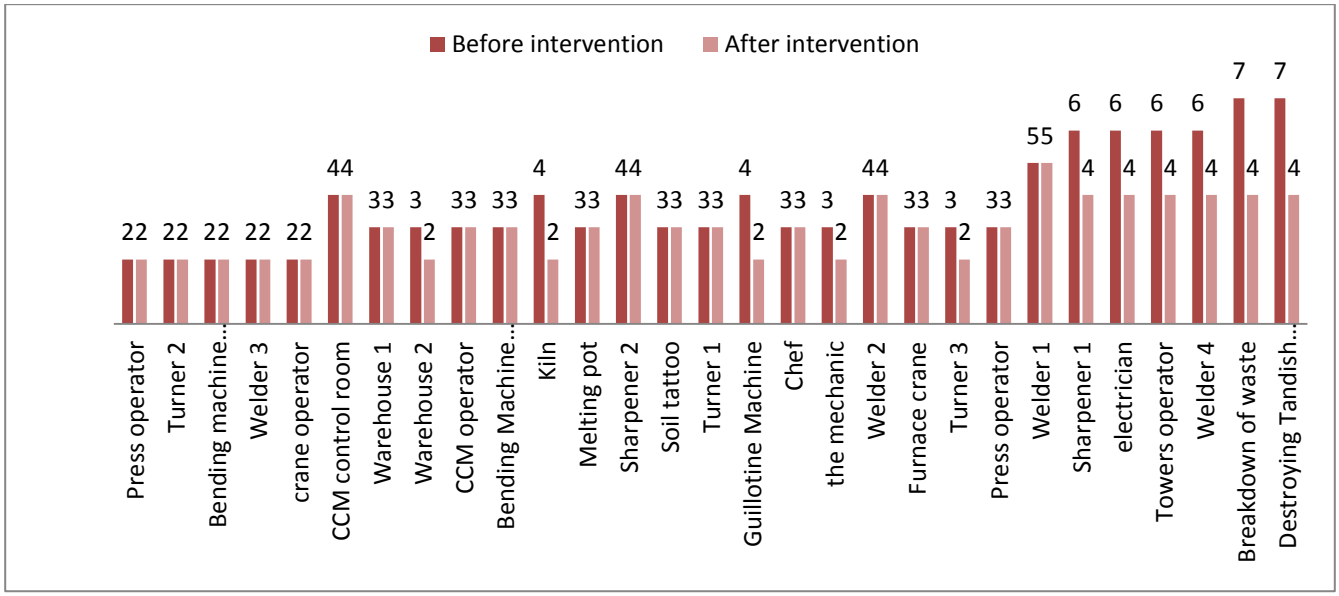
The final evaluation of scores at different work stations indicated that 17% of the stations with a risk level of 1, 59% had a risk level of 2, 17% at risk level 3, and 0.07% at risk level 4.Totally, the results of the initial assessment by the RULA technique are based on the establishment of the "waste breakdown" and "demolition work" duties at risk level 4, which makes changes and ergonomic intermediation immediately necessary (charts 1).

After initial evaluation by the RULA method, with the aim of preventing musculoskeletal disorders, corrective actions were taken by technical measures to improve the work of the destructive work station, by reducing the degree of risk from level 4 to level 2 by making the machine Tundish And the transfer of waste contained within the tandem for the unloading to the pallet, which was carried out by the overhead crane, which was also removed by the construction of the tandem, and now the

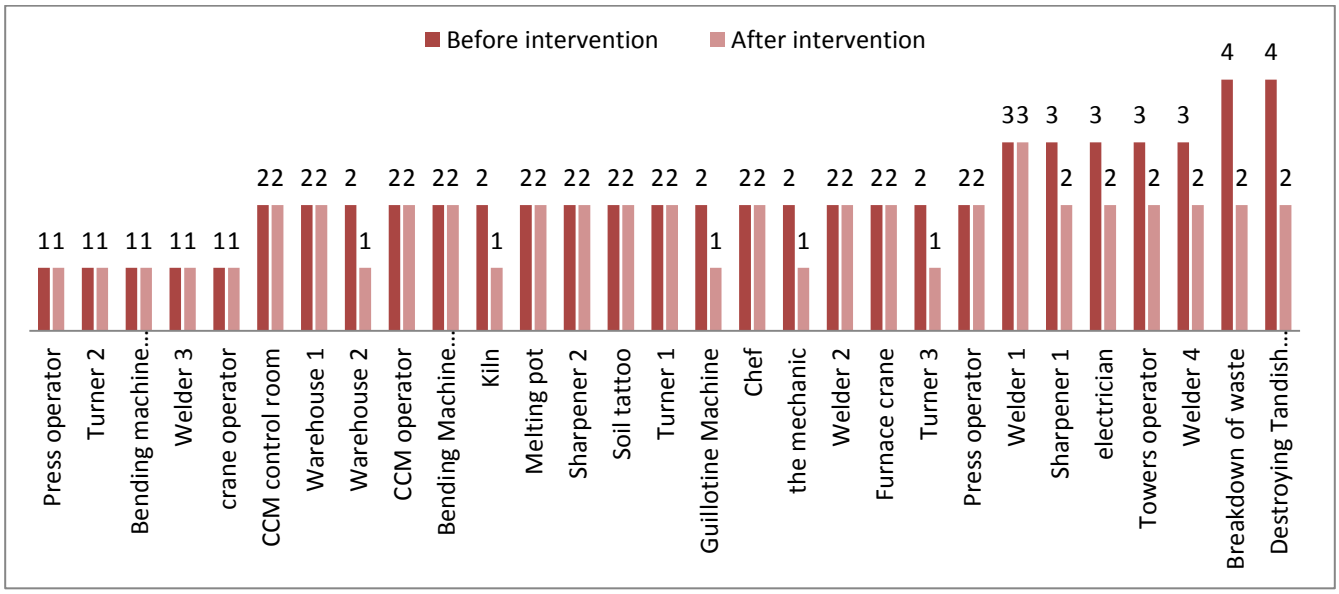
evacuation of the waste is discharged into the parcel in a controlled manner (Figures 1,2,3).
The initial risk score assigned to the RULA waste treatment workstation was reduced to level 2 after the creation of the overhead crane and the cutting table for personnel working in this area from level 4 to the level 2 (charts 2,3).



Charts 1) Percentage points of evaluation of different areas of the body before and after intervention



Charts 2) Final scores for evaluation of units before and after intervention



Charts 3) Risk Levels Results of Pre and Post Intervention Units

Figure 1) The posture destroying the Tundish work before the correction

Figure 2) Ergonomic correction and Tundish fixation

Figure 3) Tundish job demolition workstation after modification

Discussion

Musculoskeletal disorders are one of the major problems with occupational health in the heavy industry. In the current study, the consequences of the Risk-Based Musculoskeletal Disorders (RBI) Risk Assessment (RULA) were reported early in the pre-implementation study. The Majidi study in 2014, which investigates musculoskeletal disorders in the heavy metal industry, also indicates the frequency of musculoskeletal disorders in the neck, elbow, backknee and staffed areas of the staff and its relationship with fatigue (16). In other studies among metal workers, a high incidence of musculoskeletal disorders among employees has been described (17). This is in accordance with the consequences of this study. Mr. Mean's study in the Metal Stamping industry showed that the RULA score was a high stage of risk situation in this task (18).

For this reason, Interventional interventions, including engineering design, adding overhead cranes, and using appropriate desktop height and training at 29 workstations were implemented. Finally, after intervention and comparing the evaluation results before and after the intervention, ergonomic conditions improved in 37.9% (11 cases) of work stations. Corrective measures for the use of Tandic in the Tundish unit and the use of the overhead crane and the desktop to reduce the risk of musculoskeletal disorders to a satisfactory level. Omidianidost els at conducted in their study that there was a significant relationship between exercise, experience and the prevalence of back pain and it was expected that increased experience had increased the incidence of back pain (19).

The technical engineering interventions at the workstations that dismantled waste and degraded Tandic has reduced the level of risk to Level 4. The Survey of Motamedzadeh in a steel company in 2013 showed that by implementing corrective actions in the furnace unit, according to the REBA method, the level of risk of musculoskeletal disorders decreased and the prevalence of musculoskeletal disorders also decreased significantly (20). Kushwaha in 2015, with a quick assessment of the upper limb (RULA) for the cabin in the steel industry, as well as the modifications made in this study, showed that the ergonomic intervention in the workplace, reduced the lack of conformity between the machine and the human body and created a comfortable working environment For work (21). In Habibi's Survey of the corrective interventions of bus drivers, postures were corrected in parts of the body, but the modifications were not enough to allow the posture to reach the normal state (22). Yarmohammadi et al mention in their Survey that design suitable chair has an important effect on being health and without musculoskeletal disorders so purchasing chairs which are close to the ergonomic standard and educate people to sit right would have great effect on the reduction of musculoskeletal disorders (23).

In the Choobineh study, the assessment of skeletal musculoskeletal disorders and status analysis by using the RULA technique in dentists showed that the frequency of musculoskeletal disorders in dentists was high and an appropriate training program would be

effective for the improvement of musculoskeletal disorders (24).

A study on the effect of training on improving the status of the ergonomics of the work environment showed that engineering and management reforms should be alongside training in order to make ergonomic reforms. Ergonomic interventions by Saremi and colleagues showed to dentists that ergonomic interventions, such as the current study, have reduced the final scores and risk levels (25).

Conclusion

In this study, we tried to prevent the frequency of musculoskeletal disorders through the performance of engineering reforms along with the training of ergonomic principles.

One of the limitations of the project was that all participants were male and did not consider a scale to measure the severity of pain/discomfort described by the respondents.

Footnotes

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Conflict of Interest:

The authors declared no conflict of interest.

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